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Allocating the Burdens of Climate Action: Consumption-Based Carbon Accounting and the Polluter-Pays Principle

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1 Introduction

That human activity is causing profound and potentially catastrophic climate change is no longer a matter of serious debate among climate scientists. By century end, average sea levels may rise as much as 2.5 m (8 ft.), displacing millions living on the coasts.[1] Warming will exacerbate droughts, flooding, heat waves, and soil aridification, all of which seriously threaten agriculture. Zika, dengue, malaria, cholera, and other mosquito-borne illnesses will proliferate as hotter climates expand the insect's range. Warmer winds and water portend more powerful and frequent storms, and thus increased strains on critical infrastructure.

[1]National Oceanic and Atmospheric Administration et al., 2017. Cf. IPCC, AR5, WG2, pp. 366, 368–369, which predicts 0.98 m.

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Developing fair, effective, and accountable responses to these threats is essential. Central here is the question of how to allocate the costs of climate action among states (Page, 2011, p. 413).[2] Indeed, for the last thirty years, this has been *the* question of climate politics at the international level. While virtually everyone agrees that the distribution of costs should be fair, there remains serious disagreement about what constitutes fairness. This disagreement follows from a vague but critically important provision in the U.N. Framework Convention on Climate Change (or UNFCCC), which holds that states 'should protect the climate system … on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities' (UNFCCC, 1992). Political leaders have exploited the ambiguity here, invoking fairness every time they find a policy or treaty too stringent for themselves, or not stringent enough for others. For example, after being criticized for its less-than-ambitious emissions targets, India—the world's third largest emitter of greenhouse gases (GHGs)—argued that (1) at least on certain metrics, Indians have contributed very little to the climate problem and (2) even if they are responsible in a collective sense, expecting further action would be unfair, insofar as it would impede their ability to achieve critical development gains.[3] Of course, India is not the only country to advance claims like these: Many poor and developing states invoke a 'right to grow' or develop when pressed for greater climate action.

Wealthy, developed states likewise appeal to fairness to justify climate inaction—though their claims are clearly more duplicitous. The U.S. Senate, for instance, cited fairness as one of its reasons for refusing to ratify the Kyoto Protocol (Senate, 1997). More recently, President

[2]Throughout, I assume that states are the relevant duty bearers. For a critical discussion of who should bear climate duties, see Caney (2005).

[3]Quoting directly: 'Both in terms of cumulative global emissions and per capita emissions, India's contribution to the problem of climate change is limited but its actions are fair and ambitious. … Nations that are now striving to fulfill the 'right to grow' of their teeming millions cannot be made to feel guilty [about] their development agenda' (India's Intended Nationally Determined Contribution, pp. 1, 33).

Donald Trump invoked fairness concerns to defend withdrawing from the Paris Accord (Trump, 2017).[4]

The debate among states closely tracks scholarly debates over fairness in the context of climate change. Although this debate is still ongoing, climate ethicists have largely converged upon three main principles:

- The polluter-pays principle (PPP): Those responsible for causing climate change should pay, in proportion to their contribution.
- The ability-to-pay principle (APP): The wealthy should pay, in proportion to their wealth.
- The beneficiary-pays principle (BPP): Those who have benefitted from activities that cause(d) climate change should pay, to the extent they have benefitted.

Of these, the PPP is widely regarded as the most intuitively plausible and well established in international environmental law (see Sect. 2). In recent years, however, scholars have subjected the PPP to extensive criticism, for reasons examined in Sect. 3.

One avenue to resuscitate the PPP entails taking into account consumption emissions—i.e., embedded in global trade flows. Although others have proposed adopting consumption-based emissions accounting, there has been no attempt to connect this change to the PPP—or any other distributive principle. Moreover, virtually no attention has been paid to the ethical justifications for holding consumers, rather than producers, responsible—a point addressed in Sect. 4. By adopting a consumption-based emissions accounting method, the resultant distribution of burdens closely tracks economic capacity without resorting to problematic attributions of historical responsibility, as standard formulations of the PPP do. This change also offers a way to address emerging problems such as carbon leakage.

[4]Specifically, Trump (2017) said: 'The bottom line is that the Paris Accord is very unfair, at the highest level, to the United States. …I will work to ensure that America remains the world's leader on environmental issues, but under a framework that is fair and where the burdens and responsibilities are equally shared among the many nations all around the world.'

Before proceeding, it is helpful to explain what the 'climate burdens' are that must be allocated. The literature typically elucidates two, though a third is increasingly recognized.[5] First is the duty of mitigation, which involves reducing greenhouse gas emissions *and* enhancing natural 'sinks,' which absorb and store or convert emissions into non-insulating chemicals. We fulfill this duty by reducing energy usage or adopting carbon-free forms of energy production, supporting the development of green infrastructure (e.g., through technology transfers), consuming fewer animal products (Wellesley, Happer, & Froggatt, 2015, p. vii and passim; Steinfeld et al., 2006), travelling less in motorized vehicles (especially aircraft), preventing deforestation, and promoting afforestation.

A second duty is that of adaptation, which involves helping people (and perhaps other animals) adjust to climate changes.[6] We fulfill this duty by promoting access to vaccinations, constructing seawalls, and developing infrastructure (like water pumps and levees) to manage flooding and drought (Eckersley, 2015).

Finally, there is the duty to provide compensation for the 'adverse effects of climate change that cannot, or will not, be prevented through policies of mitigation or adaption' (Page, 2016, p. 84).[7] What this duty entails in practical terms remains controversial. At minimum, though, it requires the establishment of an international mechanism—like a risk-pooling insurance scheme (Arrow, Parikh, & Pillet, 1995, p. 72) or direct-aid fund—capable of providing support to states or people affected by climate change. The Warsaw Mechanism is a first step in this direction (James et al., 2014, p. 938).

Most agree that all three duties are essential. Mitigation is necessary, for instance, to prevent the crossing of 'nonlinear threshold points' (Caney, 2010, p. 205; Gardiner, 2004, p. 562)—also known as

[5]In particular, since the 18th Conference of the Parties (COP 18), in 2012.

[6]The IPCC defines adaptation as any '[a]djustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities' (IPCC, AR4, WG3, 18.1.2). See Jamieson (2010, pp. 265–266).

[7]Specifically, policy-makers define loss as 'negative impacts of climate change that are permanent' and damage 'as those impacts that can be reversed' (Huq, Roberts, & Fenton, 2013).

'tipping points'—'beyond which major changes occur that may be self-reinforcing and are likely to be irreversible over relevant time scales' (Furman et al., 2014, p. 20). Tipping points are unpredictable and very dangerous. Some tipping points, like the release of methane in the northern hemisphere's (already thawing) permafrost, risk positive feedback cycles that could generate 'runaway' global warming.[8] Given this, reducing emissions and enhancing sinks are essential; however, climate change has already progressed passed the point that all harmful changes can be avoided by mitigation alone. Because GHGs remain in the atmosphere long after they are released, even sharp emissions cuts now will not prevent global temperatures from continuing to rise well into the future (Caney, 2010, pp. 204–205). Adaptation is thus also necessary to avoid grave threats to plant, animal, and human life. Yet, there are many climate changes and events that will exceed our anticipatory adaptation capacities; thus, establishing a compensation fund for losses and damages is also crucial.

Fulfilling these three duties is quite costly. On some estimates, for instance, effective mitigation alone would cost around $780 billion (in 2015 USD$) every year, for the foreseeable future (Stern, 2007, pp. 258–262).[9] Hence our original question: according to which principle(s) should we allocate climate-action burdens? A satisfactory answer must be *comprehensive*—able to cover all three action burdens effectively, now and into the future—and *fair*—sensitive to differences in states' contributions to the problem and their differing capacities to deal with it. Anything less will fall short of the demands of accountable and effective climate governance.

In their standard formulations, none of the three principles cited above satisfy both of these desiderata. Yet, by reformulating the PPP to take account of emissions embodied in global trade flows, we can get close. Remaining shortcomings, outlined in Sect. 5, can be overcome by

[8]One analysis suggests that a large-scale methane release could generate $60 trillion in damages (Wagner & Weitzman, 2016, p. 185).

[9]For similar estimates, see Stern (2010, p. 45), Weitzman (2007, p. 720), Nordhaus (2009, p. 90). For discussion, see Caney (2009, p. 182, *n.* 9), Page (2011, p. 412), and Rendall (2011, p. 890).

supplementing the principle to produce a pluralist, bi-phasic theory of distributive climate justice that is fairer and more environmentally effective than alternatives.

2 The Polluter-Pays Principle

Many believe that those who cause harm or damage should (pay to) fix it (or compensate for any resultant suffering). Perhaps for this reason, the PPP is considered highly intuitive and has been a fixture of international environmental law well before climate change was recognized as a major problem.[10]

The principle first appears in the climate-change context in Principle 16 of the Rio Declaration on Environment and Development, which states: 'National authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution.' Notably, this formulation is (1) present oriented[11] and (2) focused primarily on reforming the behavior of economic actors. It calls on governments to require agents under their jurisdiction to include any negative environmental externalities in the price of their goods. This economistic formulation of the PPP is used widely. Nicholas Stern, for instance, argues that continued growth of greenhouse gas-emitting activities represents a major market failure, the main solution for which is to force agents to shoulder the social costs of their emissions by '[p]utting an appropriate price on carbon' (Stern, 2007, p. xviii). Notably, this way of formulating the PPP is present oriented, which simply means that it is focused on *current* pollution only—on taxing the GHGs being emitted in here and now (or at some regular interval, such as annually).

[10]An early example is the OECD's 1972 *Recommendation of the Council on Guiding Principles* (OECD, 12). See also, Article 130R of the Maastricht Treaty, the Commission on Global Governance, and IPCC, AR5, WG3, 217–218, 318, 1268.

[11]While the literature commonly refers to principles focusing on current emissions as 'forward-looking' (Shue, 1999, p. 534), to allay confusion, I opt instead for the term 'present-oriented.'

The present-oriented PPP is not only economically valuable, as a mechanism for eliminating inefficiencies (Broome, 2012); as a principle of liability, it also captures an important part of moral and political duty. Morally speaking, we want agents to get what they deserve. If someone harms or endangers others, we typically believe that agent should be held accountable—and this falls to government. As John Rawls explains, making agents pay for the 'full social cost of their action' is an 'essential task of law and government' in a just society. Hence, he defends a present-oriented PPP, pointing to 'striking cases of public harms, as when industries sully and erode the natural environment.' In such cases, Rawls argues, government must correct the 'divergence between private and social accounting that the market fails to register' (Rawls, 1999, p. 237). In practice, this means pricing emissions in a way that reflects the harm they are causing *and* some estimate of the harm they may cause (in the form of a risk premium).[12] Such a tax would provide a 'double dividend'[13]—it would curb emissions (by making them more expensive) while providing a revenue stream for financing adaptation and compensation efforts—making the principle an attractive basis for international climate policy.

3 The Case for, and Problems with, a Backward-Looking PPP

Despite its appeal, the present-oriented PPP has attracted trenchant criticism in recent years. Henry Shue, Eric Neumayer, Simon Caney, and others object to its neglect of historical emissions, arguing that agents most responsible for the emergence of climate change owe a debt of corrective justice to those adversely affected by it (Shue, 1999, p. 534ff). These scholars also contend that a purely present-oriented PPP unduly burdens developing states, which rely on emissions-heavy industrialization to sustain minimal standard-of-living. For these

[12]I elaborate this point below.

[13]See Caney (2010, n. 31; but cf. Stern, 2010, p. 62).

reasons, they endorse backward-looking PPPs (Caney, 2010; Neumayer, 2000, pp. 185–192; Moellendorf, 2012),[14] which allocate climate duties in proportion to cumulative (historical) emissions.

Concerns that a purely present-oriented PPP would heavily burden developing states are not unfounded.[15] Using standard accounting methods, six of the top ten emitters in 2012 were developing states,[16] and nearly two-thirds of all emissions came from developing and poor states. Thus, insofar as a present-oriented PPP ignores historical emissions, it manifests a compound unfairness: It forgives post-industrial states their harmful historical emissions while placing heavy burdens on those least able to bear them. On this view, corrective justice and distributive justice are better served by including historical emissions in assessments of responsibility.

3.1 Disappearing Perpetrators

As others have noted, however, this solution is practically and theoretically fraught.[17] We can note two commonly cited issues here. First, many historical polluters are now dead and therefore cannot be made to pay. Forcing their descendants to pay, as Edward Page notes, violates the 'ethos' of the PPP, which 'presupposes that only agents that actually caused an environmentally adverse outcome can be held' responsible (Page, 2011, p. 415). This is the 'disappearing perpetrators' problem. A commonly proposed solution to this problem is to hold temporally unbounded actors like states responsible. Doing so raises new issues. First, many states have undergone one or more revolutions since

[14]Note that Shue (1999) does not refer to his principle as a PPP, but—as Caney (2005, p. 753) notes—it fits the mold.

[15]The following is based on measures using the CAIT data set.

[16]Specifically, China (1), India (3), Russia (4), Indonesia (5), Brazil (6), and Mexico (10). This ranking includes emissions from land-use changes and counts any state with a per capita GDP below USD $12,000 as 'developing.' Notably, several developing states also top the list for per capita emissions and post-1990 emissions growth.

[17]For further critique of backward-looking principles, see Kingston (2014). See also Shue (1999), Singer (2002), Caney (2005, 2010), and Page (2011, 2016).

industrializing. Should states with new constitutions or leadership be responsible for the actions of the regimes they supplanted?[18] Similarly, what of former colonies? (Should emissions generated in Ghana before 1957 be attributed to the UK or the current government of Ghana?) Moreover, unless we take the implausible view that states have agency distinct from the human authorities directing them, it also seems problematic that many former authorities are dead. (For instance, the most intense deforestation in the USA occurred between 1850 and 1920 (MacCleery, 2011, p. xii); are current citizens responsible for those land-use changes, despite having no part in authorizing them?) In short, making present generations responsible for historically remote emissions fails to satisfy the central dictum 'the polluters should pay' (Posner & Weisbach, 2010, pp. 108–109).[19]

3.2 Excusable Ignorance

Until the problem of climate change became firmly established scientifically and widely known, all agents—including states—could be said to have been acting in 'excusable ignorance' of the harm their actions (particularly emitting GHGs) were causing. In response to this, Peter Singer (2002, p. 34), Eric Neumayer (2000, pp. 181, 189), Henry Shue (1999, p. 536), and others have proposed establishing a 'cut-off date' for excusable ignorance: a date after which knowledge of climate change was readily available and thus agents could be held responsible.[20] Most often, the date proposed is 1990, which is the year the first IPCC report was released.

[18]Page (2011, p. 415) argues that it would be inappropriate to hold new governments responsible for the actions of former regimes. See also Kingston (2014, p. 284ff), Caney (2006, p. 469ff), and Miller (2009, p. 151ff).

[19]Also problematically, many (and perhaps most) climate-change *victims* do not yet exist, since grounding corrective-justice claims usually requires establishing an identity between victim and wrongdoer.

[20]Singer and Shue have proposed 1990, while Neumayer suggests the mid-1980s. For critical discussion, see Caney (2005, pp. 762, 769), Page (2011, p. 415; 2016, p. 93).

Although this seems a compelling (if only partial[21]) solution, there are two complications. First, the disappearing perpetrators problem still applies, if in attenuated form. That is, many 'knowing' polluters in the period since 1990 have also died. Moreover, many of the people alive today are children or were for much of the time since 1990. Assuming we cannot hold people accountable for what happens while they are (or were) children, the number of fully culpable adults (i.e., those who were adults in the year 1990 and are still alive now) is quite small relative to all those who are alive now or were at some point between 1990 and today. If our aim is to make the polluters pay, these considerations must be taken into account when assigning responsibility—viz., we must determine how much of the global stock of atmospheric GHGs is attributable to actors no longer alive or who are or were children in the period from 1990 to today. This is a daunting, if not impossible, task. We might avoid these issues by designating states as the relevant agents, but this would raise anew many of the above issues.

Even setting these complications aside, it quickly becomes clear that focusing on post-1990 cumulative emissions does little to resolve the initial concern with the present-oriented PPP—viz., that it entails economically regressive burdens. Indeed, in 2012, five of the top ten states for *post-1990* historical emissions were developing economies.[22]

3.3 Modifying the Principle

Many have proposed revisions to the backward-looking PPP to address these and other issues. For instance, some advocate a principle of strict liability, arguing that agents should be held responsible for emissions whether or not they understood the consequences of their actions, or even could have known (Gardiner, 2004; Neumayer, 2000; Shue, 1999, pp. 531–545). Others charge that strict liability is morally questionable

[21]Some resist this move because it curtails the PPP's reach and thus its ability to serve corrective justice (Caney, 2010, p. 209; Page, 2016, p. 93).

[22]Specifically, (2) China, (3) Russia, (4) India, (7) Brazil, and (10) Mexico. NB: This is the list for emissions *excluding* land-use changes. The list *including* land-use changes is even more regressive.

(Caney, 2010; Kingston, 2014, pp. 287–288), however, and likely unserviceable as a basis for international climate policy (Baer, 2010, p. 248; Bell, 2011; Moellendorf, 2012; Posner & Weisbach, 2010; Schüssler, 2011).

Another solution involves importing a notion of 'benefitting' into the PPP which entails arguing that those who have gained 'unjustly' from historical emissions ought to pay. Caney, for instance, modifies his PPP to hold that 'if people engage in activities which jeopardise other people's fundamental interests … they should bear the costs of their actions even if they were excusably ignorant [provided] *they have benefited from those harmful activities*' (Caney, 2010, p. 210). Shue similarly argues that 'current generations in affluent states with high historical emissions are, and future generations probably will be, continuing beneficiaries of earlier industrial activity'—and thus should pay (Gosseries, 2004; Shue, 1999, p. 536; see also Neuamyer, 2000, p. 189; Page, 2016). Whether or not this offers a coherent way forward,[23] it means abandoning the PPP for a BPP, and with it, the central moral intuition that those responsible for causing a problem should pay to address it.[24] If we are to preserve this intuition, we must determine whether an alternative formulation of the PPP is available—specifically, one that tracks a plausible notion of contribution while remaining sensitive to different states' economic capacities.

4 A Revised, Present-Oriented PPP

A properly formulated, present-oriented PPP can accomplish this. Recall that the present-oriented PPP stipulates that those who contribute to climate change should pay for climate action, in proportion to their contribution. Thus, the more emissions an agent generates, the greater that agent's burdens should be. Above, we noted the concern

[23]I suggest that it does not in Sect. 5.4 (ii).

[24]Caney (2005, p. 757) recognizes this in an earlier article, but does not register the point against himself in the piece quoted above (Caney 2010). For criticisms of the BPP, see Kingston (2014, p. 288ff). For a defense, see Page (2016).

that this entails imposing heavy costs on developing countries (for instance, China, India, and Mexico), which generate significant yearly emissions.

This concern is valid *if* we adopt 'production-based' emissions accounting, which is virtually ubiquitous: It forms the basis of the UNFCCC and Kyoto Protocol calculations and is almost always used in public discussions of national emissions totals (Davis & Caldeira, 2010; Peters and Hertwich, 2008b; Steininger et al., 2014). Perhaps because of this, production-based accounting (PBA) has attracted little critical attention from climate ethicists.[25] It is not the only accounting method, nor the most normatively compelling.

An increasingly recognized alternative—consumption-based accounting (CBA)—traces emissions 'embodied'[26] in trade goods and attributes responsibility for those emissions to the country in which the goods are consumed. So, for example, using CBA, emissions generated in China to produce goods consumed in Norway are attributed to Norway. This small modification helps reveal often obscure neocolonial relations, whereby rich and powerful states outsource the production of goods to countries with cheaper labor markets, and then blame those countries for having higher emissions profiles. Chinese officials and environmental advocates have expressed particular frustration with this. For instance, at a press conference, Qin Gang, China's Foreign Ministry spokesman, once reminded Western news outlets that a 'lot of what you use, wear and eat is produced in China…On the one hand, you increase production in China; on the other hand you criticise China on the emission reduction issue' (Scientific American, 2018). Similarly, Yang Ailun of Greenpeace China claims that, in the last 30 years, '[a]ll the West has done is export a great slice of its carbon footprint to China and make China the world's factory' (Scientific American, 2018).

Taking these outsourced emissions into account could radically transform how we understand state responsibility. As Davis and Caldeira

[25]Some in the climate-policy community have raised fairness concerns, however. See Steininger et al. (2014, 2016), Davis and Caldeira (2010), Kander et al. (2015).

[26]IPCC, AR5, WG3, 306; Davis and Caldeira (2010).

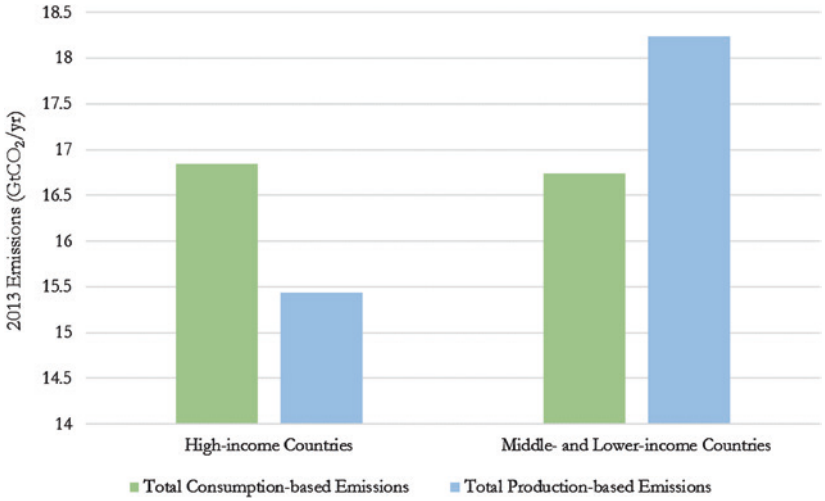

Fig. 1 Distribution of consumption—and production-based emissions

note: 'Approximately 6.2 gigatonnes (Gt) of CO_2, [or] 23% of all CO_2 emissions from fossil-fuel burning [in 2004]…, were emitted during the production of goods that were ultimately consumed in a different country' (Davis & Caldeira, 2010, p. 5688). Consequently, CBA provides a very different picture of national emissions than PBA.

We can see this in the following graph. In Fig. 1, the difference between the blue and the green columns for high-income countries, on the one hand, and middle- to low-income countries, on the other hand, shows that many of the emissions produced by the latter are embodied in goods consumed by the former.[27] This 'off-shoring' of emissions—from rich to poor and developing countries—is made possible through international trade.

Given that the biggest importers of goods from the developing world are affluent states, we should expect them to top the list for

[27]This follows the World Bank's state income grouping scheme, in which countries with a GNI per capita above USD$12,475 are considered high income. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519.

consumption-based emissions. The data show precisely this.[28] In fact, in a data set covering 119 countries[29] for the year 2013,[30] regression analysis shows that a state's GDP was a very strong and statistically significant predictor of its total consumption emissions ($R^2 = 0.76$; $p = 3.62\text{E-}38$).[31] Notably, this relationship is appreciably stronger than that between a state's GDP and its total production emissions.[32]

Of course, GNI (or GDP) per capita better reflects affluence than GNI alone.[33] Using this metric, we find that, in 2013, of the 25 countries with the highest per capita consumption emissions, all (save one, Mongolia) had a per capita GNI above $12,475, placing them in the World Bank's highest income bracket.[34] Conversely, of the states among the lowest 25 per capita consumption emitters in 2013, *none* had a per capita GNI exceeding $2,700 (the average was $1,030.40).[35] In short, the countries with the highest per capita consumption emissions are also the wealthiest.

Furthermore, the top 25 per capita consumption emitters in 2013 were responsible for 33.46% of all emissions generated that year,[36] despite representing only 10.64% of the global population.[37]

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[28]Emissions data from Peters et al. (2011). Economics and demographic data from World Development Indicators (last updated March 1, 2017), supplemented, to include Taiwan, by https://eng.stat.gov.tw/ct.asp?xItem=37408&CtNode=5347&mp=5. All economic information is reported in 2016 USD$, unless otherwise stated.

[29]NB: Poor countries are under-represented in this data set—a tendency among most CBA data sets. If they were fully included, the results would likely be even more striking.

[30]At the time of writing, 2013 is the most recent year for which most data are available.

[31]Similar results are found for GNI; $R^2 = 0.74$, $p = 1.32\text{E-}35$.

[32]The data do report a statistically significant correlation between GDP and production-based emissions ($p = 8.42\text{E-}30$), but with less explanatory power ($R^2 = 0.67$).

[33]China and India, for instance, have high GDPs/GNIs but are still relatively poor because of their large populations. Because of this, the World Bank uses a per capita measure as the basis of its income groupings.

[34]The average per capita GNI of this group was $42,863.44—almost triple the world average at the time, $14,928.37.

[35]Again, this is even more striking given that the data set excludes many poor and developing states.

[36]The consumption emissions of these states totaled 12,040.71 $MtCO_2$, while global emissions in 2013 totaled approximately 35,986.20 $MtCO_2$.

[37]Or 760,609,121 of 7,147,749,368 people.

Comparatively, the bottom 25 per capita consumption emitters, which represent 14.40% of the global population,[38] were responsible for just 1.62% of all emissions.[39] This, again, strongly suggests that consumption emissions closely track affluence.

Of course, using a consumption-based emissions accounting method effectively means shifting responsibility from producer to consumer because the underlying premise of the CBA model is that consumer demand (particularly in affluent states) is the proper locus of responsibility. There are several reasons for accepting this view.

For one, it is for the sake of satisfying consumer demand that producers undertake emissions-generating activities. Now we might worry that while consumer demand gives the reason for production, it does not, all else being equal, say anything about how production should be conducted—especially, whether producers should employ higher- or lower-emission productive processes. That decision, it seems, falls to producers. Yet, this might be too hasty. A basic axiom of supply and demand (and rational decision theory) is that when deciding between identical goods, consumers will, all else being equal, prefer whichever is cheapest. There are of course exceptions, carved out by marketing, ethical considerations, and so on. However, in most cases, price is the surest determinant of demand. If this is right, then consumers are, in effect, driving a specific kind of production: namely, cheap—which often means emissions intensive—production. In other words, consumer preferences for cheap goods dictate—in a general, but direct and significant way—producers' decisions about *how* they produce goods.

There are two additional reasons to hold consumers responsible. Affluent, consumerist states are the chief architects of today's highly liberalized trade system and global division of labor, which enables multinational firms to offshore high-emitting productive processes. In other words, the reason why production proceeds in emissions-insensitive ways is, in an important sense, because the political leadership of

[38]Approximately 1,028,951,328 people.

[39]That is, about 581.86 $MtCO_2$.

consumerists societies has structured it that way, to ensure an unimpeded stream of cheap goods. Finally, locating responsibility with consumers gives practical expression to the widely shared idea that successfully combatting climate change requires the wealthy to undertake meaningful lifestyle changes.[40] Holding consumers responsible will have the result of curbing consumption.

These points notwithstanding, clearly producers bear *some* responsibility. For in many cases, they have the ability, if not the will, to lower their emissions by adopting alternative modes of production. Yet, even granting this, two considerations should lead us to be wary about treating producers as equally responsible as consumers. First, in many if not most cases, producers lack an incentive to reduce their emissions unilaterally, for doing so would raise the price of their goods and thus decrease their market competitiveness. Of course, governmental regulation offers a potential solution to this dilemma: By requiring all productive firms in a given territory to lower their emissions, none will be made less competitive on that ground. Yet, as Fig. 1 shows, we may worry that at precisely the moment stringent emissions-reduction policies are implemented by any given state, multinational firms will simply relocate to a country without such restrictions. This dynamic is a perverse feature of our global trade system, which, again, was designed largely *by* and *for* affluent states to ensure access to cheap consumer products.

Still, conscientious producers could, for example, use advertising to instill consumer demand for lower-emissions goods (much as organic agricultural suppliers have done for pesticide-free produce), or undertake lobbying efforts to create industry-wide regulations, eliminating perverse incentives from the decision-making process. To the extent, then, that producers have failed to inform consumer preferences or reform the system, they appear to be fit objects of blame. A problem with this view, though, is that successful productive firms are often directed by agents who, themselves, are high consumers—for

[40]On this, see IPCC, AR5, WG3, 6.8, 7.9, 8.3.5, 8.9, 9.2–9.3, 9.10, 10.4, 11.4, 12.4–12.7, 15.3–15.5.

consumption largely tracks wealth at the individual level, just as it does on the international level.[41] This suggests another layer of perverse incentives. Calling on the leaders of productive firms to reform themselves or their industries is, in effect, calling on the most prodigious global consumers to make their own consumption more expensive.

Taking all of this into account, it seems that, on balance, there is a stronger case for holding consumers responsible. Doubtlessly, though, there are relevant counter-examples and exceptions in particular cases and contexts. For this reason, we might conclude that the best accounting method would be one capable of isolating the relative causal impact of consumers and producers, and assigning 'shares' of responsibility. Parsing the causal impacts of consumers versus producers, however, is—philosophically and practically—infeasible (Steininger et al., 2014, p. 78).

We must therefore pick between second-best methods and attribute responsibility accordingly. In other words, choosing between PBA and CBA is less a matter of which method better captures contribution (which both do imperfectly), but of which performs better with respect to pertinent ethical factors: especially, fairness, environmental efficacy, and cost-effectiveness. I argue that CBA is superior in these three regards and thus provides the most ethically compelling basis for allocating climate burdens.

4.1 Fairness

As already noted, CBA and PBA offer starkly different views of national emissions: CBA provides a lower-emissions count for lower- and middle-income countries, and a proportionally higher one for affluent states.[42] In this way, CBA satisfies what we might call the convergence view in the literature: that the rich ought to pay for climate action (Gardiner, 2004, p. 579). For, as shown above, a significant and robust correlation exists between GNI (per capita) and consumption emissions

[41]It is for this reason that Rawls (1999, pp. 199, 246) prefers consumption-based over income-based taxation at the domestic level.

[42]This finding is affirmed also in the most recent IPCC report (AR5, WG3, 127).

(per capita). This relationship is stronger on a present-oriented CBA model than a PBA model. Moreover, the same data used above show that there is no statistically significant relationship between per capita GNI and (post-1990) historical production-based emissions.[43] In other words, contemporary affluence is *not* a good predictor of cumulative production emissions. This suggests that those who propose counting historical emissions to satisfy the convergence view would do better to advocate a present-oriented, consumption-based PPP.

One might object that imposing a border tax (or tariff) in accordance with a present-oriented CPP would unfairly harm those in developing states, which are net exporters. I address several versions of the unfairness objection in Sects. 5.1 and 5.2. We can address the trade objection here, however. This objection can be more formally stated as follows:

a. *If* universally (or nearly universally) implemented greenhouse gas taxes are necessary, as most believe, to combat climate change successfully[44];
b. and *if* such taxes necessarily dampen trade, thereby negatively affecting developing states,
c. *then* we must choose between temporarily depressing international trade and addressing climate change.

There are strong reasons to doubt (b), or at least the provision that depressed trade must come at the cost of those in developing states. Through international aid programs, guaranteed minimum trade deals, international investments in green infrastructure, etc., any negative trade effects brought on by greenhouse gas taxes could be significantly mitigated or even reversed.

Yet, even granting (b), we should note that failing to address climate change now will almost certainly depress economic activity in the future, especially in poor and developing states, which are

[43]Regression analysis between GNI per capita and cumulative production emissions since 1990 returns a *p*-value of 0.18—far below any significant threshold.

[44]I defend this point in the next subsection.

disproportionately vulnerable to environmental changes. Furthermore, this harm would likely far exceed any foregone welfare gains related to greenhouse taxes.[45]

Suppose then that we are justified in imposing greenhouse gas taxes today.[46] The question then becomes: Is it fairer to place greenhouse gas taxes directly on producers or consumers? Although under ideal conditions there should be no difference, in our fragmented global system, placing taxes on consumption will more likely ensure that the rich pay—because, again, net consumption (consumption in excess of production) increases in rough proportion to wealth. Thus, a consumption-based model appears to be economically fairer.

4.2 Environmental Efficacy

Understanding environmental efficacy in terms of a principle's or policy's ability to 'reduce the causes and impacts of climate change,'[47] CBA has a crucial advantage: It can help prevent 'carbon leakage.' Carbon leakage, in both 'strong' and 'weak' variants, is the by-product of international free-trade agreements and fragmented mitigation policies. Strong leakage occurs when unilateral mitigation policies prompt domestic, polluting firms to relocate offshore.[48] Weak or 'consumption-induced' leakage arises from the global division of labor, which, today, concentrates production in states with energy-inefficient infrastructure.[49] In both cases, reductions in emissions in one state are offset by equal or greater increases in another.

Carbon leakage poses a problem for PBA so long as mitigation policies are not unified and there is not a single price for carbon enforced

[45]I return to this point below, via Rendall (2011).

[46]I provide a much fuller defense of this point in Mittiga (2018).

[47]IPCC, AR5, WG3, pp. 1009, 236.

[48]According to the IPCC: 'Carbon leakage is…the increase in CO_2 emissions outside the countries taking domestic mitigation action divided by the reduction in the emissions of these countries' (AR4, WG3, Chapter 11.7.2).

[49]On weak vs. strong, see Steininger et al. (2014, pp. 76, 79ff), Peters and Hertwich (2008a), Droege (2011), IPCC, AR5, WG3, p. 386.

internationally. For whenever emissions-producing activities are relocated to states with less stringent policies, regulation is undermined. To clarify, imagine state X imposes and strictly enforces a tax on greenhouse gas emissions, while state Y does not. Assuming a lack of trade barriers between X and Y, we can expect that X's policy will induce some heavily polluting companies to relocate to Y, and simply export back the goods they produce there. In this way, the emissions X sought to curtail continue, unabated. Certainly, PBA can (and will) reflect lower national emissions for X, but the aim is to reduce *global* emissions, not those of any particular state (except in an intermediate sense).

Even within a fragmented system, CBA can combat this: Through the medium of international trade, state X can enforce mitigation policies (such as a price on GHGs) outside its borders by applying tariffs to imported products. Economists call such tariffs 'border carbon adjustments'; they work by adjusting imported-product prices to reflect the social costs of greenhouse gas emissions embodied within them (Brooks, 2015; Steininger et al., 2014, p. 76). By subjecting all goods exported from states that lack (sufficiently stringent) mitigation policies to emissions taxes as a condition of market participation, CBA is able to deter free-riding. By minimizing or preventing carbon leakage in this way, CBA increases the efficacy of mitigation efforts undertaken by any trading state.

4.3 Cost-Effectiveness

By 'bringing the export sectors of the developing and emerging economies' that affluent states trade with 'into the scope of [the latter's] policy,' CBA also has an advantage in cost-effectiveness (Steininger et al., 2014, p. 81). In other words, CBA is able to capture a broader share of global emissions and because the costs of mitigation increase with the fraction of total emissions abated, this means that CBA will help identify cheaper mitigation targets. This is an example of declining marginal costs: It is cheaper and easier to reduce emissions in countries that have not decarbonized much or at all—which is the case in many developing states—and more difficult and expensive to reduce emissions in states

that are already decarbonizing—which is the case for many affluent states (Barrett, 1998; Steininger et al., 2014, p. 81; Stern, 2007). In other words, by making consumers responsible for the emissions embodied in trade goods, we incentivize emissions-reduction efforts in net-exporting countries, which can often be less costly than comparable reductions efforts in net-importing countries.

4.4 Additional Considerations

A present-oriented, consumption-based PPP offers two further advantages. First, it is sensitive to changing economic fates. As developing states become wealthier, it is essential that they commit more resources to combatting climate change. The consumption-based PPP can explain why, and to what extent, they should contribute. A backward-looking principle cannot do this; nor can it accommodate economic decline. For on a backward-looking principle, present circumstances matter little if at all. Insofar as consumption emissions decrease in accordance with economic capacity, a consumption-based, present-oriented PPP offers security: Should the rich become poor, or the poor rich, burdens change accordingly.

Second, as Davis and Caldeira note, 'to the extent that constraints on emissions in developing countries are the major impediment to effective international climate policy, allocating responsibility for some portion of these emissions to final consumers elsewhere may represent an opportunity for compromise' (Davis & Caldeira, 2010, p. 5690). In other words, a consumption-based PPP may facilitate negotiations by ensuring that the poor will not be punished for production, and that the rich will shoulder the greatest burdens without being held liable for historical emissions—something they have dearly attempted to avoid.

4.5 Summary

In short, a present-oriented, consumption-based PPP better satisfies the convergence view that the rich ought to pay for climate action, and is more environmentally effective. It is also more sensitive to changing

economic fates and may prove more politically feasible than alternatives. However, it is not free from problems. In what follows, I examine four potential objections concerning the applicability of the principle and its effects on the global poor. To avoid confusion with alternative PPPs, hereafter the present-oriented, consumption-based PPP is referred to as the *consumer-pays principle*, or CPP.

5 Objections

The first two objections elaborate on a concern expressed above: that present-oriented principles, like the CPP, *unduly* burden poor and developing states. I reject this concern in one form but accept it in another, which leads me to endorse a qualifying principle that limits the CPP's application and provides protections for economically disadvantaged states.

The latter two objections charge that the CPP is incomplete. One of these charges holds, and I respond by supplementing the CPP with an ability-to-pay principle (APP). The end result of these modifications is a pluralist, bi-phasic account of international climate justice, which is outlined below.

5.1 Unfair to the Global Poor (i): The CPP Does not Secure 'just Entitlements' to Emit

A popular view—defended (in various forms) by Baer, Neumayer, Caney, Jamieson, Singer, and others—is that everyone has an equal 'right' to generate a certain amount of emissions,[50] with quotas defined by the total absorptive capacity of the climate system divided by the number of people alive today (Caney, 2012; Gardiner, 2004, p. 583). On this view, the global rich, who have exceeded their quota, should

[50]See Gardiner (2004, p. 583ff), Caney (2005, p. 770; 2012), Neumayer (2000, pp. 185–192), Athanasiou and Baer (2002, pp. 76–97), Agarwal and Narain (1991), Jamieson (2001), Singer (2002, pp. 39–40), and Baer (2002). Politically, this view has been advocated by China, India and many less developed states.

pay for climate action, while the global poor, who are 'in credit,'[51] are entitled to further emissions (or owed compensation). Those taking this view might charge that, insofar as the CPP lacks a theory of just entitlements, it deprives the developing world of its 'fair share' of the atmospheric commons.

Although the intuitions behind claims about equal rights to emit appear generally sound, they become problematic in the particular context of climate change.[52] Given the extent to which climate change has already progressed, it is difficult, in consequentialist terms at least, to distinguish a right to emit from a right to harm. Simply too many emissions have been generated for fossil-fuel-based development to continue safely. Indeed, global mean temperatures will continue to increase as the total stock of GHGs in the atmosphere increases. Already atmospheric CO_2-e concentration levels have reached unprecedented and dangerous levels—as of February 2018, atmospheric CO_2-e exceeded 407 ppm, well above the commonly cited 'safe' upper limit of 350 ppm.[53] All new emissions beyond the earth's natural sequestration capacity can only compound the harmful effects of climate change.

One might respond here by emphasizing the relationship between emissions and standard-of-living—that is, by insisting that people must emit to sustain a minimally satisfactory life. Shue, for instance, defends a right to 'subsistence emissions' (Shue, 1993)—characterized as emissions necessary for securing a person's 'vital interests' (Shue, 1999, p. 541)[54]—and argues that this right places a duty on the rich to reduce their 'luxury emissions.' If this duty is observed, Shue and others argue, poor states could emit without jeopardizing current or future generations.

This response contains a fallacy, however: It conflates the right to a certain quality of life with a right to emit. Of course, until very

[51]Because 'their cumulative emissions are smaller than the global average per capita absorption' (IPCC, 1995, p. 94; quoted in Gardiner, 2004, p. 584).

[52]For additional criticisms, see Gardiner (2004, p. 583ff).

[53]Notably, according to ice-core samples, levels never exceeded 300 ppm in at least the last 800,000 years, and before the Industrial Revolution, CO_2e concentrations were around 280 ppm (Lüthi et al., 2008).

[54]Caney (2005) also adopts a vital-interest argument in defending a right to emit.

recently, emissions and standard-of-living were tightly correlated, such that increases in emissions were necessary to generate economic gains and thereby improve aggregate welfare. This relationship is not as rigid today as breakthroughs in renewable energy have made affordable, carbon-neutral development possible (Delucchi & Jacobson, 2011). To be sure, fossil-fuel industrialization may (in some cases) still offer the most expedient or inexpensive means for realizing welfare gains, but the desire to secure a certain standard-of-living does not justify using any means available. Moral prohibitions against harming must also be respected. That other states achieved development through fossil-fuel industrialization does not alter this, as merely citing the wrongdoing of others is insufficient for establishing standards of right or fairness.[55]

We should therefore reject claims about a right to emit founded on the right to a decent standard-of-living. Emitting GHGs in excess of the earth's absorptive capacity is harmful, and activities that unnecessarily[56] cause emissions should be limited if not prohibited.

5.2 Unfair to the Global Poor (ii): The CPP Is Not Poverty Sensitive

One might concede that a right to emit is problematic but still argue that the CPP is insensitive to developing states' interests—or sensitive only in a contingent way. For while a focus on consumption emissions *tends* to place the biggest burdens on the wealthiest states, should a poor country have high consumption emissions, as some (albeit not many) do, the CPP will impose correspondingly large burdens. Such burdens would jeopardize some states' ability to realize or maintain a decent standard-of-living (Caney, 2010, p. 213; see also Shue, 1999, 542).

[55]This would be a *tu quoque* fallacy.

[56]Unnecessarily can be interpreted in two ways here: (1) activities that contribute to climate change but are unnecessary for a satisfactory life (such as eating carbon-intensive foods, like meat and dairy products, when a plant-based diet is nutritionally sufficient and widely available) and (2) activities that are necessary for a satisfactory life but are undertaken in ways that unnecessarily result in greenhouse gas emissions (such as producing energy with coal or fracked gas when effective and clean alternatives like solar and wind are available).

The CPP should thus stipulate that climate-action burdens shall not undermine any state's ability to secure decent standard-of-living for its citizens.[57]

A few things to note about this proposed revision. First, while many argue that environmental-justice should not neglect broader distributive-justice concerns,[58] we must consider the possibility that combating climate change may not always comport with addressing economic injustice.[59] It is also possible that, given climate change's catastrophic potential, intergenerational justice may require deprioritizing today's global poor for the sake of future generations. Matthew Rendall (2011, pp. 891, 885), for instance, argues that while 'policies that deprived the poor of necessities so that the rich could continue their 'luxury emissions' … would be a crying injustice,' this 'would be a lesser injustice than risking long-term catastrophe,' because 'the prospect of condemning several more generations in the South to poverty—terrible in itself—dwindles next to the danger of *permanent* impoverishment.'[60] In other words, so long as unabated climate change threatens the essential interests of future generations in a more intense or enduring way than poverty affects today's global poor, justice may require us to prioritize addressing the former ahead of the latter.

Yet, accepting this does not alter the basic intuition that allocating climate-action burdens in a way that *unnecessarily* undermines sufficient standard-of-living is unjust. Fortunately, there appears to be no strong reason to assume that responding to climate change must come at the cost of intra-generational economic justice (Gardiner, 2006; Rendall 2011; Singer, 2010, pp. 186, 55). The thrust of the objection must still be answered, then: Ideally, fair allocations of climate burdens

[57]I set aside the question of what counts as a sufficient minimum. Shue (1999, p. 541) defines it as 'enough for a decent chance for a reasonably healthy and active life of more or less normal length,' which extends beyond bare survival to those goods necessary for 'a distinctively human, if modest, life.' For other thresholds, see Shue (1993), Caney (2005, 2010, p. 218), and Singer (2002).

[58]Shue (1999), Caney (2005, 2012, pp. 258–259). But cf. Posner and Weisbach (2010).

[59]Posner and Weisbach (2010) stress this. I also take up this point in Mittiga (2018).

[60]Rendall (2011) later argues that imposing costs on poor states is probably unnecessary, assuming it is possible to shift the burdens of climate change onto future generations.

should strictly track contribution to the problem *and* be sensitive to capacity.[61] The CPP succeeds on the first front, but not necessarily on the second because it *tends* to impose greater burdens on rich states but is not constitutionally committed to this.

To meet this objection, we must recognize a qualifying principle external to the CPP. This principle presupposes a distinction between climate action itself and the costs of that action. For example, if the CPP results in the imposition of a universal carbon tax, this qualifying principle might hold that, at regular intervals, more advantaged states have a duty to provide tax rebates to less advantaged states. We can call this principle the economic justice qualifying principle (or EJQP). It can be expressed alongside the CPP as follows:

CPP: Climate-action burdens should be allocated in proportion to contribution, measured in terms of each state's annual consumption emissions.

EJQP: However, wealthy states[62] have a duty, in proportion to their wealth, to ensure that climate-action costs do not unnecessarily compromise any state's ability to attain or preserve decent standard-of-living.

One need not accept a thick cosmopolitan ethic to endorse the EJQP; rather, one need only to maintain that it is wrong to harm others, wherever they are in the world.[63] The IPCC's *Third Assessment Report* stresses that '[a]ny individuals' or nations' actions to address the climate-change issue, even the largest emitting nation acting alone, can have only a small effect.'[64] In other words, each state requires the cooperation of all or most others to mitigate climate change successfully. Consequently, attempting to structure international climate action in a way that

[61]This idea is reflected in the 'common but differentiated responsibilities' doctrine (UNFCCC, 1).

[62]In this context, 'wealthy' refers to states belonging to the World Bank's 'high-income' and 'upper middle-income' groups. For an inventory of these states, and of those in the 'lower middle' and 'low-income' groups, see IPCC, AR5, WG3, A.II.2.3, pp. 1287–1288.

[63]The argument in this paragraph draws on Shue (1999, p. 541ff).

[64]IPCC, AR3, WG3, 607. See also IPCC, AR5, WG3, pp. 5, 214, 136.

unnecessarily undermines the realization or preservation of a decent minimum standard-of-living in developing states amounts to a will to harm—provided, as Shue notes, 'that interfering with people's ability to maintain a minimum for themselves count[s] as a serious harm' (Shue, 1999, p. 542). Put more simply, if forcing the least advantaged to sacrifice is unnecessary, it is also harmful and unfair, regardless of other considerations.

Note, however, that this does not relieve poor and developing states of their climate-*action* responsibilities—it does not imply, for instance, that poor states are entitled to delay mitigation policies. Poor and developing states, like all states, have duties not to exacerbate climate change, but satisfying this duty can rightly be predicated on more advantaged states fulfilling their obligation, specified by the EJQP, to ensure that the strains of international cooperation do not unnecessarily compromise the vital interests of the least well off.

5.3 Incomplete (i): The CPP Cannot Ground Duties to Enhance Carbon Sinks

Simon Caney distinguishes between 'atomist' and 'holist' accounts of climate justice. Atomist accounts offer a separate and distinct principle for each climate burden (such as mitigation, adaptation, and compensation), whereas holist accounts treat climate burdens 'en masse,' with a single principle (Caney, 2012, pp. 258–259).[65] I have presented my account as holist. One might challenge this, however, on the grounds that the CPP is fundamentally aimed at discouraging bads (such as the generation of greenhouse gas emissions), not promoting goods, and thus cannot provide for the *enhancement* of carbon sinks, like forests and certain marine habitats (Armstrong, 2016; Duarte et al., 2013; Page, 2016, p. 85). Thus, for any account to be truly holist, it must be able to offer a principled basis for ensuring that sinks are properly maintained and duly expanded.

[65]Caney also notes that there can be intermediate accounts covering some but not all climate burdens.

Although this is a serious objection, a simple response may be available. With estimates of the annual sequestration capacity of particular forests and marine habitats, credits could be awarded to the states maintaining them. This would simply require regarding the sinks as consumable goods that provide annual returns (in the form of carbon sequestration capacity)—a kind of rent-deriving property.

Several advantages would follow from this. First, providing credits for sinks would open a stream of benefits for poor and developing states, thereby correcting for the disproportionate burdens they currently bear in preserving what are, after all, collective goods (Armstrong, 2016; Page, 2016, p. 89). Relatedly, if an international market was established in which the rights to these credits could be leased, poor and developing states could secure direct financial transfers from wealthy states seeking to lower their yearly emissions totals, without ceding control of the territories hosting the sinks. Second, awarding credits would incentivize the maintenance and expansion of carbon sinks. Indeed, a credit system effectively doubles the value of a sink since razing a forest would entail both losing a credit (equivalent to the sequestration capacity) and incurring a fee (equivalent to the carbon emitted from the land-use change). These calculations may seem complex, but factoring sequestration credits and land-use changes into national emissions estimates is already common practice; thus, incorporating them into a consumption-based model poses no insuperable difficulties.

5.4 Incomplete (ii): The CPP Cannot Allocate Burdens Without Human Pollution

The final objection is that the CPP cannot provide a coherent basis for allocating climate-action burdens in two important cases: when human activity (i) is not or (ii) is no longer driving climate change.

5.4.1 Anthropogenic and Non-anthropogenic Climate Change

Consider, first, the IPCC's claim (cited in Caney, 2010, p. 211) that 'most of the warming observed over the last 50 years is attributable to

human activities.' As this implies, other natural processes also contribute to global warming, if in a far less pronounced way. This poses a problem for the CPP. Specifically, because the CPP allocates burdens in proportion to contribution, distinguishing between anthropogenic and non-anthropogenic climate change seems necessary. In making this distinction, however, another problem arises: The CPP appears unable to address non-anthropogenic climate change.[66]

In response, we should first note that non-anthropogenic climate change would almost certainly not be a cause for concern were it not for our gross exacerbation of the problem (US Environmental Protection Agency). Given this, polluters should be held responsible for the problem as a whole. We know (and have known for decades) that climate change is real and that human activity is causing changes that almost certainly would not have occurred without our interference. In this sense, when we contribute to climate change, in awareness of what our actions entail, this confers on us a general responsibility for the outcomes that follow, *even if* the problem might have occurred, to some extent, without our interference.

Moreover, by dint of being present oriented, the CPP has a more expansive notion of contribution—one that includes damages caused *and* risk imposed. That is, when internalizing an activity's social costs, the CPP includes a 'risk premium,' which reflects the magnitude and likelihood that damages or losses associated with that activity will come to pass. Notably, such risks need not be caused *exclusively* by human activity. If a given risk is great enough, society may simply wish to ensure that all activities contributing to it are discouraged or stopped. Consequently, distinguishing between anthropogenic and non-anthropogenic climate change is unnecessary. A reasonable aversion to risk in general, and the knowledge that human activities are increasing the likelihood or potential magnitude of a given risk, suffices for grounding responsibility.

[66]Caney (2010, p. 211) registers a version of these concerns against his backward-looking PPP.

5.4.2 Climate Change Without Polluters

The second charge—that the CPP cannot allocate shares of responsibility once human activity ceases to contribute to climate change—is more difficult to address. Consider the following. If the CPP is successful, emission flows will decline, perhaps falling below the earth's sequestration capacity before long. Yet, even with an immediate and precipitous emissions drop, climate change may continue to cause problems for centuries to come. This, again, is because many GHGs endure in the atmosphere long after they are emitted.[67] Consequently, distributing the costs of adaptation and compensation will likely remain an important international issue well after we reach the point of carbon neutrality. Given that the CPP allocates duties in proportion to present contribution, however, it seems inapplicable during a 'post-mitigation' period. As emissions decline, eventually the revenue the CPP generates from justly priced taxes on GHGs will be insufficient for covering the expenses related to adaptation and compensation. Thus, the CPP is incomplete.

Answering this objection requires supplementing the CPP with a principle that can explain how to correct for any deficits between the revenue generated by taxing emissions and the total cost of climate-action burdens for any given year. There are two clear possibilities: a BPP and an APP.

Recall that a BPP assigns burdens to those who have benefitted from the activities that gave rise to climate change, in proportion to their benefit (Page, 2016). While this seems plausible within intermediate time horizons, it becomes incoherent when applied to the distant future. Recall that climate change will likely persist far after the point that dangerous emissions are generated. What would a BPP commit us to? Would it be fair, 500 years from today, to hold a completely carbon-neutral country responsible for the remaining burdens of climate action because of the benefits its citizens once received from fossil-fuel

[67]For instance, while about 60% of carbon dioxide (CO_2)—the most common GHG—will cycle out of the atmosphere within 200 years after being released, up to 20% will remain for 'tens of thousands of years' (Hausfather, 2010).

industrialization? Would it matter if economic fates shift over this time—if a once-rich country becomes relatively poor, for instance? What if it is no longer a state at all? As time progresses, these questions compound, making the BPP less and less coherent.

We might attempt to preempt these issues by isolating the stream of wealth directly generated by greenhouse gas emissions and using this as the limit of liability. Page, for instance, argues that responsibility under the BPP ought to end at the point that the 'benefits traceable to activities that drive climate change are exhausted' (Page, 2016, p. 91). Isolating the particular benefits derived from climate-inducing activities would be a tremendous practical challenge.[68] Assuming this could be done, however, we might wonder what to do when the limit is reached. Given the long atmospheric lives of many GHGs, it is possible that this stream of wealth will be exhausted well before adaptation and compensation are no longer concerns. If this is right, then the BPP will itself have to be supplemented, thus raising again the original problem.

A more parsimonious—and less theoretically fraught—solution would be to supplement the CPP with the APP, which again holds that the wealthy should pay proportionately for the costs of climate action. Darrell Moellendorf, Caney, Page, and others have used the APP to supplement the central principles in their accounts (typically a backward-looking PPP or BPP) (Caney, 2005, 2010; Moellendorf, 2002, pp. 97–100; Page, 2011; Shue, 1999). This seems appropriate here as well. In other words, in a post-mitigation phase of climate change, the APP likely offers the most coherent basis for allocating climate duties.

6 Conclusion

We now have a pluralist, bi-phasic account of climate justice, the three pillars of which are as follows:

[68]How can we isolate a benefit that arose from activities that cause climate change from those resulting from, e.g. sea access, education investments, or luck? An agent's economic success is predicated on numerous factors, a mere inventory of which would be confounding.

CPP: Climate-action burdens should be allocated in proportion to contribution, measured in terms of each state's annual consumption emissions.

EJQP: However, wealthy states have a duty, in proportion to their wealth, to ensure that climate-action costs do not unnecessarily compromise any state's ability to attain or preserve a decent standard-of-living.

APP: Once consumption emissions decrease to the point that the revenue gained from taxing them can no longer sustain the remaining costs (related to adaptation and compensation claims), wealthy states should shoulder those burdens in proportion to their wealth.

While this account is not as picturesque as one that simply holds 'the polluter should pay,' it is markedly more coherent; and, because it covers all the relevant climate burdens, now and into the future, it is also more comprehensive. Moreover, the account is alive to both the contributions and capacities of different actors in both phases. In particular, the first phase of the account, covered by the CPP and EJQP, is contribution determined and capacity sensitive, while the latter phase, covered by the APP, is determined by and sensitive to capacity. In this regard, it is responsive to the claims of both compensatory and distributive justice.

Several questions remain. For instance, should historical emissions after the excusable ignorance cut-off date be taken into account and, if so, how? Should the CPP apply at the subnational level? And to what extent, if any, should we discount future welfare when setting emissions tax rates? These questions must be addressed in future work. The aim here, however, has been simply to show that the PPP (*qua* CPP) can provide a politically feasible, ethically compelling, and environmentally effective basis for allocating climate burdens among states.

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